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US005805334A

United States Patent [19]

Takahashi

[11] Patent Number: 5,805,334

[45] Date of Patent: Sep. 8, 1998

[54] CATADIOPTRIC PROJECTION SYSTEMS

[75] Inventor: Tomowaki Takahashi, Yokohama, Japan

[73] Assignee: Nikon Corporation, Tokyo, Japan

[21] Appl. No.: 858,560

[22] Filed: May 19, 1997

[30] Foreign Application Priority Data

May 20, 1996 [JP] Japan 8-149903

[51] Int. Cl.⁶ G02B 17/08; G03B 27/42

[52] U.S. Cl. 359/364; 359/727; 359/732; 359/784

[58] Field of Search 359/364, 365, 359/366, 727, 728, 732, 784

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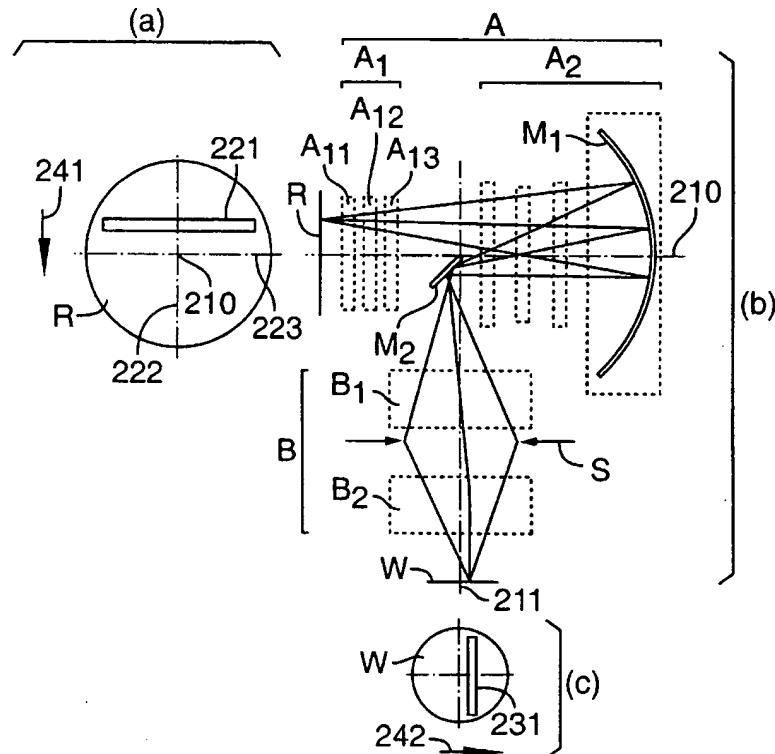
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[57] ABSTRACT

Catadioptric projection systems are disclosed for projecting an illuminated region of a reticle onto a corresponding region on a substrate. The systems are preferably used with ultraviolet light sources (e.g., 193 nm). The systems comprise a first imaging system, a concave mirror, and a second imaging system. The first imaging system comprises a single-pass lens group and a double-pass lens group. The single-pass lens group comprises a first negative subgroup, a positive subgroup, and a second negative subgroup. Light from the illuminated region of the reticle passes through the single-pass lens group and the double-pass lens group, and reflects from the concave mirror to pass back through the double-pass lens group to form an intermediate image of the illuminated region of the reticle. The light is then directed to the second imaging system that re-images the illuminated region of the reticle on the substrate. Alternatively, light from the single-pass lens group is reflected by a turning mirror to the double-pass lens group, wherein the light returning through the double-pass lens group continues directly to the second imaging system.

26 Claims, 5 Drawing Sheets



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The United States of America



The Commissioner of Patents and Trademarks

Has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this

United States Patent

Grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America for the term set forth below, subject to the payment of maintenance fees as provided by law.

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If this application was filed on or after June 8, 1995, the term of this patent is twenty years from the U.S. filing date, subject to any statutory extension. If the application contains a specific reference to an earlier filed application or applications under 35 U.S.C. 120, 121 or 365(c), the term of the patent is twenty years from the date on which the earliest application was filed, subject to any statutory extension.

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